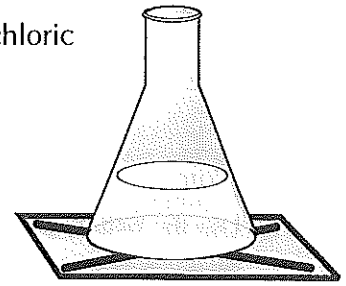
Experiments on Rates of Reaction

Q1 *The reaction between sodium thiosulphate and hydrochloric acid produces a yellow precipitate of solid sulphur. This makes the solution cloudy and prevents us seeing clearly through it. The cross below the flask in the diagram will slowly disappear as the sulphur is produced.*

In an experiment to investigate rates of reaction, the time taken for the cross to disappear was recorded.

50cm³ of sodium thiosulphate solution was used and 10cm³ of hydrochloric acid was added.

The experiment was repeated at different temperatures.



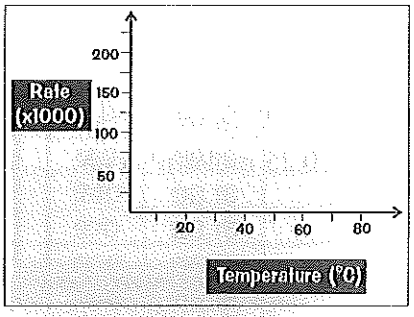
Temperature (°C)	20	30	40	50	60	70
Time taken (s)	163	87	43	23	11	5

a) Use these results to **plot a graph**, with time taken on the vertical axis and temperature on the horizontal axis.

b) **Use the graph** to draw a simple conclusion about the effect of temperature on the time taken for the reaction to finish.

c) The rate of a reaction may be found by dividing 1 by the time taken (1/t). **Work out** the rate at each of the above temperatures.

d) **Plot a graph** of rate against temperature *(If the actual numbers for the rate value are too small to plot, use 'Rate x 1000' on the vertical axis).*



e) **Use your graph** to draw a simple conclusion about the effect of temperature on the RATE of a chemical reaction.

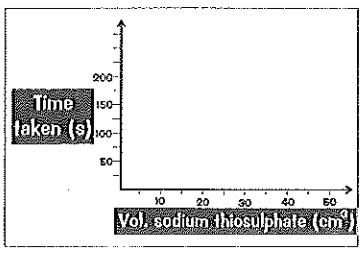
f) Use your knowledge of the collision theory to **explain** your conclusion.

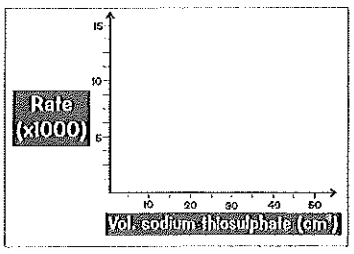
Q2 *The same reaction can be used to investigate the effect of* CONCENTRATION *on the rate of a reaction. In changing the concentration, it is important to keep the total volume used exactly the same.*

Volume of sodium thiosulphate (cm³)	50	40	30	20	10
Volume of water (cm³)	0				
Time taken (s)	80	101	137	162	191
Rate (1/t)					

a) **Complete** the table, adding the volume of water and calculating the rate of the reaction.

b) **Plot graphs** showing the time taken against volume of sodium thiosulphate used, and also rate against volume of sodium thiosulphate used.





c) Use these graphs to draw a **simple conclusion** about the effect of concentration on the reaction rate.

d) **Explain** your conclusion in terms of particles and the collision theory.

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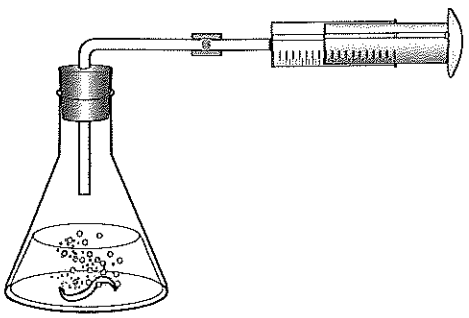
Q3 *When magnesium reacts with acid, hydrogen gas is given off. This can be collected and measured as a way of measuring the rate of the reaction.*

In this experiment 25cm³ of dilute hydrochloric acid (0.5mol/dm³) was reacted with a small amount of magnesium ribbon (the acid was in excess).



a) Write a balanced equation for this reaction. *(Mg + HCl → etc.)*

b) Use the results below to plot a graph of volume collected (vertical axis) against time (horizontal axis).

Time (s)	0	10	20	30	40	50	60	70	80	90	100
Vol. hydrogen (cm³)	0	9	18	27	36	44	50	54	56	57	57

c) Mark on your graph where the reaction is going at a constant rate.

d) How much hydrogen was collected in the first 25 seconds?

e) How long did it take to collect 40cm³ of hydrogen?

f) Sketch on the same axis the graphs you would expect if the experiment was repeated using 25cm³ of:

1.0 mol/dm³ acid ..... mark this A.

2.0 mol/dm³ acid ..... mark this B.

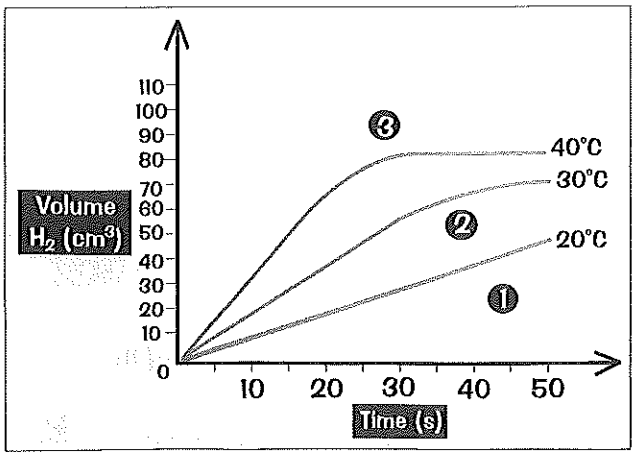
0.25 mol/dm³ acid ..... mark this C.

Q4 *A similar experiment can be carried out to investigate the effect of changing the temperature on the rate of reaction. The graph below shows results from such an experiment. The acid is increasingly warmer in experiments 1, 2 and 3 .*

a) What simple conclusion can you draw from these graphs?

b) For each graph, calculate the rate over the first 10 seconds.

c) What do you notice about the change in the rate of the reaction for an increase of 10°C?



Top Tips:

Lots of graph-drawing practice here. Always make sure you've included a title, axis labels and units and check the scale's about right. They'll look at all these in the Exam, and losing marks is so easy.